

# **NUTRIENT REDUCTION IN THE FLATHEAD BASIN**

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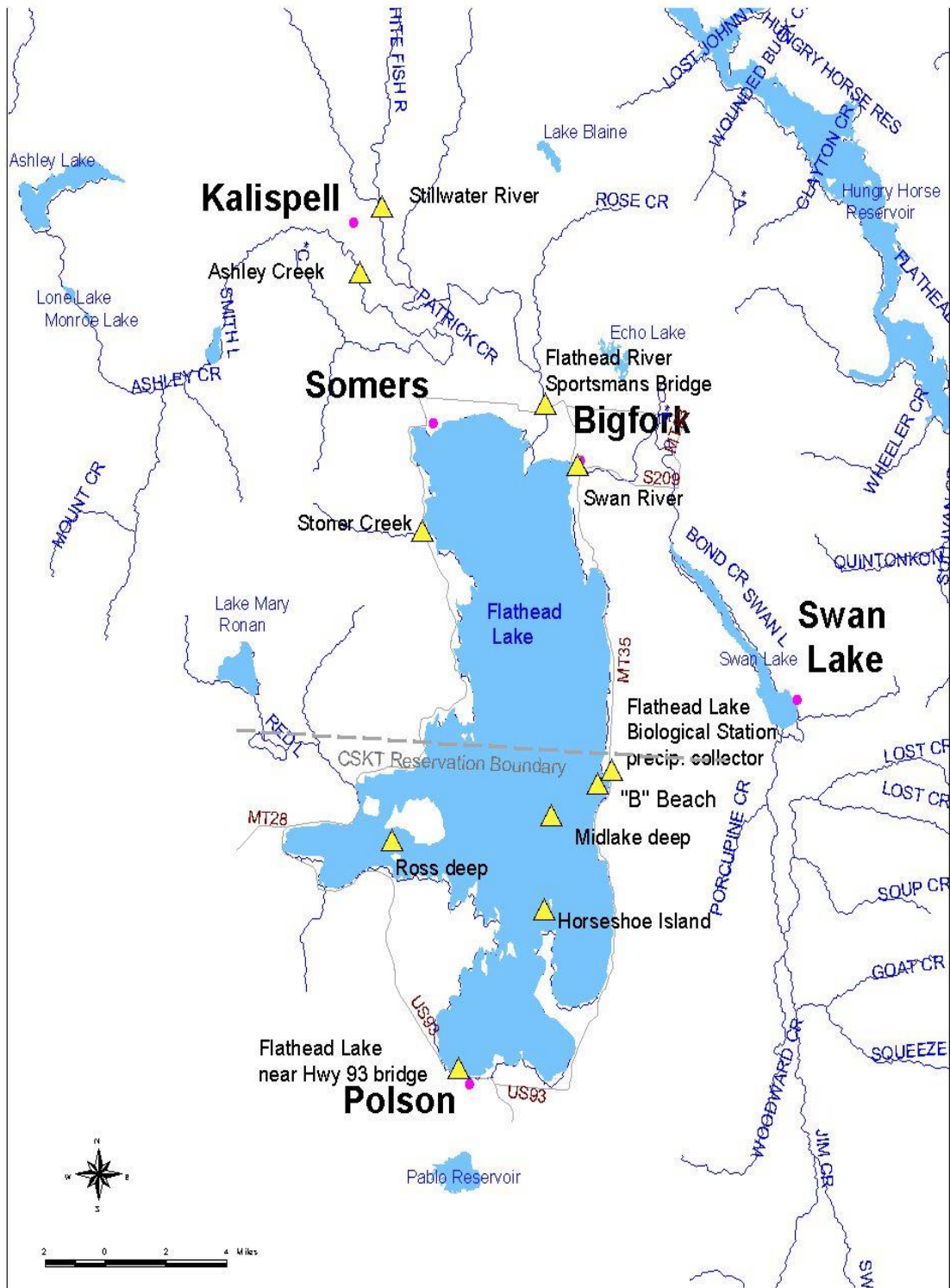
## **Abstract**

Increased nitrogen and phosphorus loads emanating from upstream tributaries, atmospheric deposition, and groundwater accelerate the utrophication process in Flathead Lake. Less than two percent of the annual nutrient load is estimated to come from point sources. Impacts from anthropogenic nonpoint pollution sources are clearly demonstrated in monitoring data. Efforts are underway by the Flathead Basin Commission (FBC) and others to reduce the nutrient load by 15 percent and achieve interim water quality targets. The goal of the interim targets is to realize water quality conditions monitored in 1978 through implementation of the Voluntary Nutrient Reduction Strategy (VNRS). A Total Maximum Daily Load (TMDL) is also pending, which will formalize interim targets, focus nutrient reduction needs, and allocate sources. VNRS actions include watershed efforts that encourage citizens to take on local water quality improvement, basin outreach, education, assessments, monitoring, and identification of critical nutrient reduction in the Flathead Basin, such as sewerage Flathead Lake and encouraging BMPs on developing urban and agricultural lands.

## **1.0 Water Quality Concerns in Flathead Lake**

Understanding the nutrient reduction and the Voluntary Nutrient Reduction Strategy (VNRS) in the Flathead Basin begins with understanding water quality problems and water quality monitoring data for Flathead Lake (Figure 2-2). Through scientific studies and research conducted for more than two decades, experts from the Flathead Lake Biological Station (FLBS), state and federal agency personnel working on Flathead Lake, and many others agree that water quality in Flathead Lake has degraded (Stanford et al. 1997). Nutrient loading in the form of phosphorus and nitrogen, among others, are significant water quality concerns in Flathead Lake, and appear to be the primary limiting factor controlling future water quality conditions (FBC 2001). If allowed to continue, the utrophication process (Turk, 1985) will accelerate, forever changing the Flathead Lake ecosystem (MDHES 1984).

As lakes age, they accumulate nutrients, algal production increases (such as floating algae seen on Flathead Lake), clarity decreases, and oxygen is depleted (MDHES 1984 and EPA 1999). All of these indicators are observed in scientific data for Flathead Lake, which is detailed by Stanford et al. (1997, and 1994, 1992) and Ellis et al. (1998). Of particular concern is the depleted oxygen in Flathead Lake, which demonstrates the aging process is accelerated, harms the fishery, and changes the lake ecology. Figure 3 and Table 1 outline impacts and the nutrient loads to Flathead Lake. Primary productivity is a critical indicator for Flathead Lake (Figure 3) and portrays the amount of carbon in the water. It is used to characterize the amount of biologic activity in the water column, which relates to the amount of nutrients encouraging the biologic activity. If you



**Figure 2-2. Flathead Lake Sampling Sites**

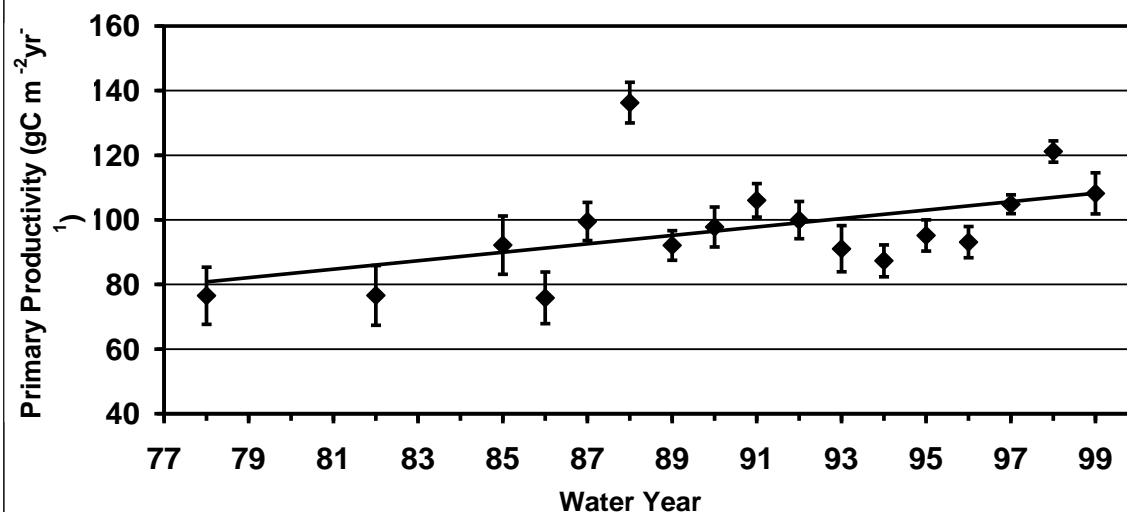
**Figure 2-2**

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**Figure 3. Primary Productivity Trends in Flathead Lake.**



**Table 1. Summary of nitrogen and phosphorus loads to Flathead Lake (adapted from Stanford and Ellis, 2001).**

Watersheds	BioTP load		TN load		NO <sub>2</sub> /3 load	
	MT/yr	%	MT/yr	%	MT/yr	%
Main-stem Flathead(1)	85.96	60.28%	1067.15	69.90%	545.41	75.13%
Swan	7.09	4.97%	108.44	7.10%	30.84	4.25%
Stillwater/Whitefish	12.73	8.93%	119.72	7.84%	48.29	6.65%
Ashley Creek	6.12	4.29%	66.3	4.34%	22.14	3.05%
Stoner Creek	0.15	0.11%	1.04	0.07%	0.11	0.02%
Other shoreline creeks(2)	1.57	1.10%	11.42	0.75%	4.45	0.61%
Shoreline septic (3)	3.7	2.59%		NA	28	3.86%
Precipitation	22.97	16.11%	131.34	8.60%	40.28	5.55%
Point Sources	2.309	1.62%	21.21	1.39%	6.393	0.88%
Total Load	142.599		1526.62		725.913	

(1) Excluding loads from the Stillwater/Whitefish and Ashley Creek Basins.

(2) Estimated using nutrient data from Yellow Bay Creek (n=24) and estimated annual discharge from 20 of the larger shoreline creeks (see Stanford et al. 1983 and Potter 1978). This is likely an underestimate.

(3) From Makepeace and Mladenich, 1996

lower the nutrient load, you lower the primary productivity in Flathead Lake. Therefore, nitrogen and phosphorus are the nutrient limiting factors for Flathead Lake. Improving Flathead Lake water quality by reducing the nutrient load is a primary goal of the Flathead Basin Commission (FBC), which is a basin-scale watershed group appointed by the Governor to improve water quality in the Flathead Basin. To this end, the FBC developed the VNRS as non-regulatory voluntary process for citizens and stakeholders to work together to make important strides toward reducing nonpoint source pollution in the basin (FBC, 2001).

## 2.0 Point Sources, Nonpoint Source Nutrient Pollution and Water Quality Targets

The problem of nutrient loading is far from new and dates back to 1984 when the Montana Department of Environmental Quality (formally the Water Quality Bureau) developed the *Strategy for limiting Phosphorus in Flathead Lake* (MDHES, 1984). Clear goals were set forth in the 1984 strategy, and most goals focused on reducing point source pollution (e.g., wastewater treatment plant discharge). Now, less than 2 percent of the nutrient load entering Flathead Lake is estimated to come from point sources (Table 1) due to successful wastewater treatment plant upgrades completed over the last 10 to 15 years. Unfortunately, the +90 percent load reductions in point source pollution are negated from increased nonpoint source pollution. The majority of nutrients entering Flathead Lake are the result of both natural and anthropogenic nonpoint source pollution. The probable sources of nonpoint source pollution include atmospheric deposition, domestic wastewater lagoons, flow regulation/ modification, on-site wastewater treatment systems (septic tanks), urban sprawl, overland runoff, agriculture, timber harvesting, and an upstream impoundment (MDEQ 2000). The VNRS and pending Total Maximum Daily Load (TMDL) are focused on reducing major nutrient sources.

In 1998, the FBC worked with a panel of experts to develop interim nutrient reduction targets for Flathead Lake based on the 1978 primary productivity indicator level of 80 grams carbon/m<sup>2</sup>/year (FBC 1998) (Table 2). To bring the lake back to the 1978 level, the FBC determined that nitrogen, nitrate plus nitrite, and phosphorus loading has to be targeted for a 15 percent reduction basin wide for nonpoint sources. The pending TMDL advocates an additional 10 percent reduction to account for uncertainty and future population growth. Implementation of the VNRS program is the primary program underway to meet the interim targets. The targets are also used in the pending TMDL for Flathead Lake (MDEQ, in progress), and coordinating both the VNRS and implementation of the TMDL is currently under consideration by the FBC.

**Table 2. Comparison of Targets to Current Conditions in Flathead Lake.**

Parameter	Target	Water Year 2000 data*
Primary production	80 g C m <sup>-2</sup> yr <sup>-1</sup>	108 g C m <sup>-2</sup> yr <sup>-1</sup>
Dissolved oxygen in the hypolimnion	No oxygen depletion	79.5% of saturation at midlake deep site
Blooms of Anabaena or other pollution algae	No measurable blooms	Data not yet analyzed
Chlorophyll a	1.0 ug/L	1.0 ug/l
Algal biomass on near-shore rocks	Measured as Chl a per unit area, biomass remains stable or exhibits declining trend	Data collection effort just beginning
Total phosphorus (TP)	5.0 ug/l	5.9 ug/l
Soluble reactive phosphorus (SRP)	<0.5 ug/l	0.7 ug/l
Total nitrogen (TN)	95 ug/l	101 ug/l
Nitrite + Nitrate (NO <sub>2/3</sub> -N)	30 ug/l	43 ug/l
Ammonia (NH <sub>3</sub> - N)	<1.0 ug/l	5.1 ug/l

\*Provided by the Flathead Lake Biological Station

### 3.0 VNRS Implementation

The ultimate goal of the FBC's basin planning effort is to improve the water quality of Flathead Lake (FBC 1999). In the process, streams and lakes throughout the basin will benefit from improved public understanding of water quality issues and a variety of efforts to reduce pollution through actions taken at the neighborhood level by those most affected. The VNRS was started in 1999 to accomplish this, designed to be a broad spectrum voluntary effort focused on a host of nonpoint pollution sources in upstream tributaries, unique watersheds, groundwater, the airshed, and Flathead Lake itself. There are six principal components designated to implement the VNRS including: (1) coordination and planning, (2) retaining grant funding, (3) establishing partnerships and conducting public outreach, (4) establishing watershed groups, (5) identifying new opportunities, and (6) monitoring. The FBC hired a VNRS coordinator to oversee the implementation of VNRS and begin a watershed by watershed restoration strategy. To this end, the VNRS coordinator started watershed groups in the Ashley Creek Watershed in 2000, and recently in Stoner Creek (FBC 2001), where local residents help plan and implement watershed scale restoration. Future watershed efforts will likely focus north of Flathead Lake on urban and agricultural lands associated with the Stillwater and Whitefish Rivers where data show the highest nutrient loads per acre.

The VNRS coordinator assists watershed groups by applying for grant funding and developing partnerships to complete watershed assessments, plan restoration efforts, and fund on-the-ground restoration. The FBC emphasizes that local groups establish water quality goals and restoration objectives. It will take many years for all watersheds in the Flathead to have planning efforts underway and retain adequate funding for assessment, restoration, and education. However, the FBC is confident that working at the watershed scale is critical for a successful VNRS. Most importantly, watershed restoration projects are based on local watershed needs, working with agency partners, and designed to improve water quality. By assessing and planning watershed activities for an entire watershed, the causes of degradation can be reduced or even eliminated while efforts to restore processes can speed watershed recovery (King 1999).

Some VNRS efforts are implemented at the basin scale, and have so far focused on education and demonstration projects, such as workshops for installation of native buffer zones along waterways. Basin-scale efforts also involve monitoring needed to track water quality improvement as projects are completed. Monitoring includes voluntary efforts led by the FBC for streams, lakes, and wetlands; monitoring by the FLBS; and also tribal and state monitoring. New basin scale efforts involve assessing potential shallow groundwater nutrient load impacts and assessing atmospheric nutrient loading into Flathead Lake. While there is substantial evidence to support water quality impacts in Flathead Lake, these types of assessments are needed to develop restoration plans and realistic alternatives to achieve water quality targets.

#### 4.0 Future Nutrient Reduction

The overall scope of the VNRS is focused on reducing nonpoint source pollution. Efforts integrate adaptive management and will most likely have to be implemented in perpetuity as long as the Flathead Basin is both a destination for new development and a fragile ecosystem. Similar to Lake Tahoe, the scale of projects and funding will need to be increased in order to reduce nutrient loads. In late 2001, a VNRS implementation plan will be drafted by the FBC to summarize goals, active projects, outline a clear path for future VNRS efforts, develop new ideas for nutrient load reduction, and eventually meet the interim targets for Flathead Lake water quality. This plan may include TMDL implementation components and coordination needs if the FBC elects to take on this important mission. If adopted by the FBC as part of their nutrient reduction mission, the FBC will need to expand coordination efforts to ensure all basin nutrient reduction projects by other entities are linked to achieve water quality targets. Lastly, the overall effort will have to adapt as conditions change and data are collected, expand outward as funding allows, and franchise efforts in other parts of the basin if they are demonstrated to be successful.

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